

REMARKS

The Examiner and his supervisor are thanked for the interview courteously granted to the undersigned and employees of the Assignee of the above-identified application, in connection with the above-identified application. During this interview, hand-outs were given to the Examiner for showing unexpectedly better results achieved according to the present invention, wherein the recited medium has a pH of 3 or less (that is, a relatively low pH) and oxidizing agent in a concentration of from 0.01% by weight to 3% by weight (that is, a relatively low amount of oxidizing agent). It was pointed out to the Examiner that by utilizing such medium having a relatively low pH and relatively low concentration of oxidizing agent, whether with or without abrasive grains, the polishing medium can be effectively used for polishing tantalum and tantalum nitride, e.g., used as barrier layers for copper conductors in manufacturing semiconductor devices; and, moreover, according to additional aspects of the present invention, such medium can selectively polish barrier layers of, e.g., tantalum and tantalum nitride, with respect to a conductor layer of copper. The hand-outs given to the Examiner included a first hand-out showing the chemical effect on removal rate of three media (Chemicals A, B and C), with Chemical A being within the scope of the present claims while Chemical B had a relatively large concentration of oxidizing agent and Chemical C had a relatively high pH. Only Chemical A achieved a relatively high polishing rate of tantalum nitride with relatively low polishing rates of copper and silicon oxide.

A second hand-out given to the Examiner during the aforementioned interview showed the impact of pH on the polishing rate. As seen therein, a pH of three or less (that is, a relatively low pH) shows a high removal rate of tantalum and tantalum nitride,

while avoiding a disadvantageously large removal rate of copper.

A third hand-out given to the Examiner during the aforementioned interview showed the impact of oxidizing agent (H_2O_2) concentration on polishing rate, the data showing that a low H_2O_2 concentration (of equal to or less than 3.0 wt%) in the medium exhibits a high tantalum removal rate and low copper removal rate, while increasing the H_2O_2 concentration disadvantageously increases the removal rate of copper.

A fourth hand-out given to the Examiner showed the impact of oxidizing agent (H_2O_2) concentration on removal rates, where the polishing medium contained a water-soluble polymer (ammonium polyacrylate (PAA)). See Table 1 on page 38 of Applicants' specification. It was pointed out that this hand-out shows that at relatively low oxidizing agent concentrations, with the polishing medium including the water-soluble polymer, much better results are achieved in increased polishing rates of the tantalum and tantalum nitride, as compared with the polishing rate of copper.

Another fifth hand-out was given to the Examiner, showing effect of abrasive size on removal rate, for polishing media within and outside the scope of the present claims. The above-referred-to Chemical A, within the scope of the present claims, and Chemical B, outside the scope of the present claims, were used with respect to removal of barrier layer materials (TaN and Ta) and silicon dioxide. It was pointed out by the undersigned that the data in the fifth hand-out showed that Chemicals A and B exhibit an opposite tendency on tantalum and TaN removal, and that the smaller the size of the abrasive grains the higher the removal rate, using Chemical A, while the opposite effect occurred using Chemical B.

In view of the data in the hand-outs, it was contended by the undersigned, during the interview, that unexpectedly better results are achieved according to the present

invention with respect to relatively high polishing rates using polishing media within the scope of the present claims, as compared with use of polishing media outside the scope thereof, with respect to polishing rate of barrier layer materials such as tantalum and TaN, and particularly effective results are achieved when taking into account selectivity of polishing of these barrier layer materials as compared with a conductor of, e.g., copper.

During the interview, the Examiner pointed out that most of the prior art rejections were anticipation rejections. In response thereto, the undersigned noted that the bases for the rejections were, at most, overlap between disclosures in the applied references and the presently claimed subject matter, and particularly in view of advantageous effects achieved according to the present invention, such overlap did not establish anticipation.

The Examiner also pointed out during the interview that the previously considered claims were broad, with the broadest claims thereof generally reciting a polishing medium for chemical-mechanical polishing and not reciting specific materials, e.g., for the conductor, and not defining specific materials being polished.

No agreement was reached during the interview.

The claims of the above-identified application have been amended in order to further clarify the definition of various aspects of the present invention. Specifically, Applicants have cancelled previously considered claims 23, 24 and 37, which were independent claims previously considered in the above-identified application. Moreover, Applicants are presently adding independent claims 59, 62, 65, 69, 73, 77, 85, 89, 93 and 97 to the application. Of these newly added claims, claims 73 and 77 are method claims, while claims 59, 62, 65, 69, 85, 89, 93 and 97 are directed to a

polishing medium.

Claim 59 recites a polishing medium "adapted to polish a barrier layer of tantalum, tantalum alloy or a tantalum compound, for a conductor of copper, copper alloy or copper oxide". This claim recites that the medium includes an oxidizing agent; a protective-film-forming agent; an acid and water, with the polishing medium not including abrasive grains, and wherein the polishing medium has a pH 3 or less and includes the oxidizing agent in a concentration of from 0.01% by weight to 3% by weight. Claim 62 corresponds to claim 59, but specifically recites that the medium includes abrasive grains.

Claim 65 defines a polishing medium for chemical-mechanical polishing of a surface having at least one of tantalum, tantalum alloy and a tantalum compound. Claim 65 recites that the medium includes an oxidizing agent; and protective-film-forming agent; an acid and water, and further recites that the polishing medium does not include abrasive grains, that the polishing medium has a pH of 3 or less, and includes oxidizing agent in a concentration from 0.01% by weight to 3.0% by weight. Claim 69 is similar to claim 65, but expressly recites that the polishing medium includes abrasive grains.

New independent claim 73 defines a method of polishing a substrate member including a step of polishing a barrier layer containing tantalum, a tantalum alloy or a tantalum compound by the use of a polishing medium for chemical-mechanical polishing, this polishing medium being defined. That is, claim 73 recites that the polishing medium includes an oxidizing agent, a protective-film-forming agent, an acid and water, and further recites that the polishing medium does not include abrasive grains and has a pH of 3 or less, and includes the oxidizing agent in a concentration of

from 0.01% by weight to 3% by weight. Claim 73 further defines polishing-rate ratios of the polishing medium.

New independent claim 77 defines a method of polishing a substrate member having a barrier layer containing at least one of tantalum, a tantalum alloy and a tantalum compound overlying an insulator and a conductor layer containing at least one of copper, a copper alloy and copper oxide on the barrier layer. This claim recites that the method includes chemical-mechanical polishing the conductor layer, using a first chemical-mechanical polishing medium, so as to remove portions of the conductor layer and expose portions of the barrier layer, in a first step; and thereafter chemical-mechanical polishing exposed portions of the barrier layer using a second chemical-mechanical polishing medium, the second chemical-mechanical polishing medium being defined as including an oxidizing agent, a protective-film-forming agent, an acid and water, and further recites that the polishing medium has a pH of 3 or less and includes the oxidizing agent in a concentration of from 0.01% by weight to 3% by weight.

New independent claims 85, 89, 93 and 97 recite a polishing medium. Claims 85 and 89 recite that this medium is adapted to polish a barrier layer of specified tantalum-containing materials for a conductor of specified copper-containing material, and claims 93 and 97 recite that the medium is for polishing of a surface of specified tantalum-containing material. These claims recite specific materials in the polishing medium; and claims 85 and 93 recite that the medium does not include abrasive grains, while claims 89 and 97 specifically recite that the medium does include abrasive grains.

As for these newly added claims, note, for example, the paragraph bridging pages 7 and 8; and Examples starting on page 26 of Applicants' specification.

Applicants have amended previously considered claims in light of, inter alia, canceling of claims 23 and 24 and adding, e.g., claims 59 and 62 to the application. In addition, claim 27 has been amended to recite that the concentration of the oxidizing agent in the polishing medium is in a range of from 0.01% by weight to 1.8% by weight, where the medium includes a water-soluble polymer; and claims 54-57 have been amended to recite that the oxidizing agent has a "concentration" of from 0.15 to 3% (or to 1.5%) by weight. Furthermore, in light of addition of new claim 67, claim 39 has also been canceled without prejudice or disclaimer; and in light of canceling of claim 37 without prejudice or disclaimer, claim 58 has also been canceled without prejudice or disclaimer.

In addition to new claims 59, 62, 65, 69, 73, 77, 85, 89, 93 and 97, Applicants are also adding new claims 60, 61, 63, 64, 66-68, 70-72, 74-76, 78-84, 86-88, 90-92, 94-96 and 98-100 to the application. Claims 60 and 63, dependent respectively on claims 59 and 62, recite that the polishing medium has a property that a ratio of a polishing rate of the barrier layer using the polishing medium, to a polishing rate of the conductor using the polishing medium, is greater than 1; and claims 61 and 64, also dependent respectively on claims 59 and 62, recite that the polishing medium includes the oxidizing agent in a concentration of from 0.01% by weight to 1.8% by weight. Claims 81 and 82, each dependent on claim 77, respectively recites that the second chemical-mechanical polishing medium does not include abrasive particles, and recites that this medium contains abrasive particles. Claims 83 and 84, each dependent on claim 77, respectively recites that the first polishing medium is different from the second polishing medium and polishes the copper-containing material at a higher polishing rate than the polishing rate by the first polishing medium of the tantalum-containing material;

and recites that the insulator includes dales, the barrier layer being provided in the dales and the conductor layer filling the dales. As for the first polishing medium, note, for example, pages 13-15 of Applicants' specification. Remaining newly added claims further define the pH of the polishing medium and concentration of the oxidizing agent.

Noting the concurrently filed RCE Transmittal, it is respectfully submitted that entry of the present amendments is clearly proper, notwithstanding Finality of the Office Action mailed October 4, 2004.

The rejection of claims 54-57 under the first paragraph of 35 USC 112, set forth in Item 9 on page 7 of the Office Action mailed October 4, 2004, is noted. Claims 54-57 have been amended to recite a concentration of the oxidizing agent, consistent with the description in Applicants' original disclosure as set forth, for example, in the paragraph bridging pages 7 and 8, and in the paragraph bridging pages 10 and 11, of Applicants' specification. Particularly in view of the present amendments to the claims, reconsideration and withdrawal of the rejection of claims 54-57 under the first paragraph of 35 USC 112 is respectfully requested.

Applicants respectfully submit that all of the claims now presented for consideration by the Examiner patentably distinguish over the teachings of the prior art as applied by the Examiner in rejecting claims in the Office Action mailed October 4, 2004, that is, the teachings of the U.S. Patents to Lee, et al., No. 6,171,352, to Kaufman, et al., No. 5,954,997, and to Hardy, et al., No. 6,238,592, under the provisions of 35 USC 102 and 35 USC 103.

It is respectfully submitted that the references as applied by the Examiner would have neither disclosed nor would have suggested such polishing medium as in the present claims, with or without abrasive grains, the polishing medium being adapted to

polish a barrier layer of tantalum, a tantalum alloy or a tantalum compound, for a conductor of copper, copper alloy or copper oxide, with the medium including, inter alia, an oxidizing agent, and a protective-film-forming agent, an acid and water, and wherein the polishing medium has a pH of 3 or less and includes the oxidizing agent in a concentration of from 0.01% by weight to 3% by weight. See claims 59 and 62. Note also claims 85 and 89, reciting specific materials in the medium.

Moreover, it is respectfully submitted that the applied references would have neither disclosed nor would have suggested such polishing medium as in the present claims, as discussed previously, including abrasive grains, and wherein the abrasive grains have an average particles diameter of 50 nm or less and the abrasive grains have a standard deviation of particle size distribution in a value of more than 5 nm. See claim 25.

Furthermore, it is respectfully submitted that the applied references would have neither taught nor would have suggested such polishing medium as in the present claims, having features as discussed previously in connection with claim 62 (including the abrasive grains), and wherein the medium further includes a water-soluble polymer, with the concentration of oxidizing agent in the polishing medium being in a range of from 0.01% by weight to 1.8 % by weight. Note, for example, claim 27; see also claim 42.

In addition, it is respectfully submitted that these references as applied by the Examiner would have neither taught nor would have suggested such a polishing medium for chemical-mechanical polishing of a surface having at least one of tantalum, tantalum alloy and a tantalum compound, with this medium including, inter alia, an oxidizing agent, protective-film-forming agent and acid, with or without abrasive grains,

and wherein the polishing medium has a pH of 3 or less and the oxidizing agent is included therein in a concentration of from 0.01% by weight to 3.0% by weight. See claims 65 and 69. Note also claims 93 and 97, reciting specific materials of the medium.

Furthermore, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested a method of polishing a substrate member, including polishing a barrier layer containing tantalum, a tantalum alloy or a tantalum compound by the use of a polishing medium for chemical-mechanical polishing, wherein the polishing medium includes an oxidizing agent, a protective-film-forming agent, the polishing medium having recited polishing-rate ratios of tantalum or tantalum nitride to copper and of tantalum or tantalum nitride to silicon dioxide as in the present claims (see claim 73); and/or the polishing medium for chemical-mechanical polishing having components as referred to previously, and having a polishing-rate ratio of tantalum-containing material to copper-containing material that is greater than 1 (see, e.g., claims 60 and 63; note also claims 38 and 51).

In addition, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such a method of polishing a substrate member as in the present claims, including a step of polishing a surface including a wiring layer and a barrier layer, by the use of the polishing medium set forth in claim 51. See claim 53.

Furthermore, it is respectfully submitted that the teachings of the applied prior art would have neither disclosed nor would have suggested such a method of polishing a substrate member having a barrier layer containing at least one of tantalum, a tantalum alloy and a tantalum compound overlying an insulator and a conductor layer containing

at least one of copper, a copper alloy and copper oxide on the barrier layer, including first and second chemical-mechanical polishing steps respectively removing portions of the conductor layer with exposing portions of the barrier layer and polishing exposed portions of the barrier layer, using first and second chemical-mechanical polishing media, with the second chemical-mechanical polishing medium including a medium as recited in claims 59 and 62. That is, the applied prior art would have neither disclosed nor would have suggested the two-step chemical-mechanical polishing procedure of the present invention, as in, e.g., claim 77.

Moreover, it is respectfully submitted that the teachings of the applied prior art would have neither disclosed nor would suggested the other aspects of the present invention as in the remaining, dependent claims, including (but not limited to) the amount of abrasive grains mixed into the polishing medium, as in, for example, claim 26; and/or wherein the oxidizing agent is included in the polishing medium in a concentration of from 0.01% by weight to 1.5% by weight (note, for example, claim 29; see also claims 44, 68, 72, 76, 80, 88, 92, 96 and 100); and/or wherein the acid of the polishing medium is an organic acid (see, e.g., claim 30), in particular wherein such acid is at least one selected from the group thereof set forth in claim 31; or such method of polishing a substrate member including a step of polishing a barrier layer containing tantalum, a tantalum alloy or a tantalum compound, by the use of the medium of claim 51 (or a method of polishing a substrate member including polishing a surface including a wiring layer and a barrier layer, using the medium of claim 51).

Moreover, submitted herewith is a Declaration under 37 CFR 1.132 of Mr. Y. Kurata, one of the named inventors in the above-identified application, providing evidence of unexpectedly better results achieved according to the present invention

including ranges of amount of oxidizing agent, and pH of the medium, as in the present claims. As discussed infra, this evidence clearly rebuts any contention by the Examiner that the teachings of the applied references establish an anticipation of the presently claimed subject matter; and, moreover, it is respectfully submitted that this evidence establishes unexpectedly better results so as to clearly support a conclusion of unobviousness of the presently claimed subject matter. Note Manual of Patent Examining Procedure (MPEP) 2131.03, sub-section II.

The present invention is directed to a polishing medium for chemical-mechanical polishing, useful with or without abrasive grains, additional aspects of the present invention including further improvements when the medium includes abrasive grains, and methods of polishing using the medium.

In metal formation such as in the formation of damascene wirings of copper or copper alloy or the formation of plug wirings of tungsten, a phenomenon called "thinning" in which the thickness of wiring becomes small together with an interlaminar insulating film may occur when an interlaminar insulating film of, e.g., silicon dioxide, is polished at a rate close to the rate of polishing the metal film. As a result, there may be caused an increase in wiring resistance or a non-uniformity in resistance ascribable to pattern density. Hence, it is desired that the polishing medium for chemical-mechanical polishing have a property that the polishing rate of a silicon dioxide film is sufficiently smaller than that of the metal film to be polished. Note the last paragraph on page 5 of Applicants' specification.

It is also desired that in performing the metal polishing, "dishing" of the surface of the metal wiring, wherein the surface becomes hollow at the middle thereof like a dish, resulting in a bad effect on flattening, be avoided.

In chemical-mechanical polishing of, e.g., a layer of copper or copper alloy of wiring, together with polishing of, e.g., a layer of tantalum, tantalum alloy, tantalum nitride or other tantalum compound as a barrier layer, a two-step polishing method has been proposed, having a first step of polishing the copper or copper alloy and a second step of polishing the barrier layer conductor. In this two-step method, and in particular in the second step of polishing the tantalum-containing material, used for the barrier layer, it is important to polish the barrier layer without thinning the silicon dioxide film, and also while avoiding dishing of copper-containing material of the wiring. Note, in particular, the paragraph bridging pages 6 and 7 of Applicants' specification.

Against this background, and as a result of extensive studies performed by the present inventors, the inventors have discovered that the polishing of the tantalum-containing materials proceeds with ease when the polishing medium has both a low pH and the oxidizing agent is included in the medium in a low concentration. Thus, according to the present invention, Applicants provide a polishing medium having specified components, including an oxidizing agent and a protective-film-forming agent, wherein the polishing medium has a pH of 3 or less and the oxidizing agent is included in a concentration of from 0.01-3% by weight, achieving objectives of the present invention of a relatively high polishing rate of the material of the barrier layer, while avoiding dishing and thinning, respectively, of the, e.g., copper wiring and of the oxide insulator, and which additionally can avoid scratches from occurring in the wirings. Thus, as described on pages 8 and 9 of Applicants' original disclosure, the present inventors have discovered that the polishing of the tantalum, tantalum alloy, tantalum nitride and other tantalum compounds which are used as the barrier layer proceeds with ease in a low pH range and where the oxidizing agent is included in the medium at a

low concentration. Moreover, at such low pH and low concentration of the oxidizing agent, etching rate of copper or copper alloy does not increase, avoiding dishing problems.

More specifically, as described in the sole full paragraph on page 16 of Applicants' specification, in general when the polishing medium has a pH of less than 3, etching rate of the copper or copper alloy film is so high as to make it difficult for the protective-film-forming agent to control the etching. However, in the present invention, the concentration of the oxidizing agent is so sufficiently low that the protection-film-forming agent can control the etching.

Furthermore, by utilizing abrasive grains having an average particle diameter as in various of the present claims, the polishing rate of silicon dioxide is decreased, avoiding any "thinning" problems. See the paragraph bridging pages 21 and 22 of Applicants' specification.

As for unexpectedly better results achieved according to the present invention, attention is respectfully directed to the enclosed Declaration under 37 CFR 1.132, and in particular the Experiments described therein and experimental results set forth therein.

As seen in Additional Experiment 1 on pages 1-4 of the Declaration, Chemical A, within the scope of the present invention, achieved a high removal rate of tantalum nitride and tantalum as compared to the removal rate of copper and silicon oxide, while Chemicals B C, outside the scope of the present invention, had higher rates of polishing of copper and also had relatively low polishing rates of the tantalum-containing materials. Additional Experiment 2 on pages 5 and 6 of the Declaration shows that with use of polishing medium according to the present invention, including abrasive grains,

the removal rate increased with decrease of abrasive size, which is unexpected (removal rate increasing with increased abrasive size using chemicals outside the scope of the present claims, or in removing silicon oxide using Chemical A within the scope of the present claims or Chemical B outside the scope of the present invention). In Additional Experiment 3 on pages 7 and 8 of the Declaration, it can be seen that a high removal rate of tantalum nitride and tantalum, as well as improved selectivity of removing tantalum-containing compounds as compared with copper, is achieved at relatively low pH within the scope of the present claims. Additional Experiment 4 on pages 9 and 10 of the Declaration shows that at relatively low oxidizing agent concentration (a concentration of less than 3% by weight), polishing rate of tantalum and tantalum nitride are relatively high, as compared with concentrations over 3% by weight; and selectivity for removal of tantalum-containing compounds as compared with polishing of copper can be achieved at relatively low oxidizing agent concentration. Additional Experiment 5 on pages 11 and 12 of the Declaration shows that with polishing media containing a water-soluble polymer (polyacrylic acid ammonium salt), decreased oxidizing agent concentration achieves increased removal of tantalum-containing materials, contrary to expectation; and, moreover, at low oxidizing agent concentration, a selectivity for removal of tantalum-containing material relative to removal of copper can be achieved. Additional Experiment 6 on pages 13 and 14 of the Declaration shows that decrease of pH can achieve a high polishing speed for tantalum and tantalum nitride materials, which is the opposite result achieved in connection with copper and titanium nitride films. That is, as seen in Additional Experiment 6, polishing speeds of the copper film and the titanium nitride film show behaviors completely different from that of the tantalum-containing film.

It is respectfully submitted that these Additional Experiments 1-6 show unexpectedly better results with respect to polishing of tantalum-containing materials, for polishing media and methods as in the present claims having a relatively low pH and a relatively small amount of oxidizing agent, supporting unobviousness of the presently claimed invention.

It is acknowledged that in the Office Action mailed October 4, 2004, the Examiner has applied Lee, et al. and Kaufman, et al. in anticipation rejections, under 35 USC 102. However, as is clear from MPEP 2131.03, when the prior art discloses a range which touches, overlaps or is within the claimed range, but no specific examples falling within the claimed range are disclosed, in order to anticipate the claims the claimed subject matter must be disclosed in the reference with "sufficient specificity to constitute an anticipation under the statutes". As stated in MPEP 2131.03, if the claims are directed to a narrow range and the reference teaches a broad range, and there is evidence of unexpected results within the claimed narrow range, it may be reasonable to conclude that the narrow range is not disclosed with "sufficient specificity" to constitute an anticipation of the claims; and the unexpected results may also render the claims unobviousness. It is respectfully submitted that the present circumstances are just such a situation; and it is respectfully submitted that the evidence of record clearly establishes non-anticipation, as well as unobviousness, of the presently claimed subject matter, even with respect to any overlap between the teachings of the applied prior art and the present invention.

Lee, et al. discloses a chemical-mechanical abrasive composition for semiconductor processing, which includes 70-95% by weight of an aqueous medium, 1-25% by weight of an abrasive and 0.1-20% by weight of an abrasion accelerator, the

abrasion accelerator including a monocarboxy group- or an amido group-containing compound and optionally a nitrate salt. See column 2, lines 38-48. This patent goes on to disclose that the abrasive composition can further include 1-15% by weight of, and preferably 4-8% by weight of, an oxidant. See column 2, lines 63-65. Note also column 3, lines 3-7 for specific oxidants. This patent further discloses that when used in a copper production process, the abrasive composition may include benzotriazole and/or its derivatives to inhibit rapid copper corrosion. See column 4, lines 13-20. Note also column 4, lines 30-40, for a disclosure of adjustment of the pH, with respect to polishing various materials. Note also specific compositions in the Examples.

It is respectfully submitted that Lee, et al. would have neither taught nor would have suggested the combination of relatively low pH and relatively low amount of oxidizing agent, and advantages thereof, e.g., in polishing tantalum-containing materials with a high polishing rate, and/or with selectivity relative to polishing copper-containing materials.

Kaufman, et al. discloses a chemical mechanical polishing slurry including a complexing agent, at least one oxidizer, at least one abrasive and a film-forming agent. See column 1, lines 8-13. Note also column 4, lines 9-21, describing one embodiment of the slurry, as including from about 0.3-12.0 weight % hydrogen peroxide. See also column 5, lines 15-18, 32-39, 44, 45, 50-56 and 60-63; and column 6, lines 17-25. See also the Examples in this patent, beginning at column 9.

It is respectfully submitted that Kaufman, et al. would have neither disclosed nor would have suggested the relatively low pH and relatively small amount of oxidizing agent, and advantages thereof, as discussed previously.

Note that Kaufman, et al. discloses that the chemical-mechanical slurry disclosed

therein has a high copper, titanium, titanium nitride and tantalum nitrate and acceptable tantalum polishing rates. See column 8, lines 35-42. Such disclosure would have neither taught nor would have suggested the unexpectedly high tantalum-containing material polishing rate as achieved according to the present invention, and, moreover, the selectivity towards polishing of the tantalum-containing material as compared with, e.g., polishing of copper.

It is respectfully submitted that Hardy, et al. would not have rectified the deficiencies of Kaufman, et al., such that the presently claimed invention would have been obvious to one of ordinary skill in the art.

Hardy, et al. discloses a family of working liquids useful in modifying exposed intermediate surfaces of structured wafers for semiconductor fabrication, the liquids including an oxidizing agent; an ionic buffer; a passivating agent; a chelating agent selected from aminodiacetic acid and salts thereof; and water. See column 3, lines 29-39; note also column 4, lines 19-32. As to the abrasive used in Hardy, et al., note column 7, lines 18-30, and the paragraph bridging columns 7 and 8. Note also the paragraph bridging columns 9 and 10 of Hardy, et al., describing that the average particle size of the inorganic particles should be less than about 1000 Angstroms, preferably less than about 500 Angstroms, and more preferably less than about 250 Angstroms.

Even assuming, arguendo, that the teachings of Hardy, et al. were properly combinable with the teachings of Kaufman, et al., such combined teachings would have neither disclosed nor would have suggested the medium having the relatively low pH and relatively small amount of oxidizing agent, as in the present claims, and unexpectedly better results achieved thereby.

The contention by the Examiner that Lee, et al. teaches a pH including 1-3, the Examiner referring to column 4, lines 31-40 thereof, is noted. However, it must be emphasized that Lee, et al. discloses various pH values for different materials, including a pH for polishing copper of 3.0 to 4.5 or 6.0 to 7.0 (that is, including values outside ranges of the present claims). It is emphasized that Lee, et al. provides no disclosure of a pH for a medium polishing tantalum-containing materials. It is respectfully submitted that Lee, et al. would have neither disclosed nor would have suggested the presently claimed medium and method of use thereof, and advantages achieved thereby. While Lee, et al. may disclose oxidizing agent concentration overlapping with that set forth in the present claims, note that the preferred oxidant amount in Lee, et al. is greater than the maximum amount recited in the present claims. It is respectfully submitted that Lee, et al. would have neither taught nor would have suggested ranges for pH and for amount of oxidizing agent as in the present claims, and unexpectedly better advantages achieved thereby.

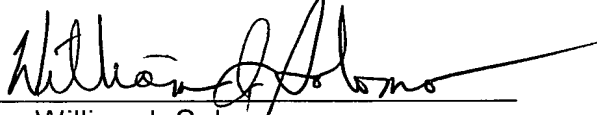
Similarly, as applied by the Examiner Kaufman, et al. discloses amounts of oxidizer overlapping with the range recited in the present claims and also a pH which overlaps. Moreover, it is emphasized that Kaufman, et al. is directed to slurry useful for polishing copper. It is respectfully submitted that the teachings of this reference would have neither disclosed nor would have suggested the ranges for pH and for amount of oxidizing agent as in the present claims, and advantages thereof, in particular wherein a relatively high polishing rate of tantalum-containing material is achieved, with selectivity toward polishing the tantalum-containing material as compared with polishing of copper-containing material.

In view of the foregoing comments and amendments, and also in view of the presently submitted Declaration, and in light of the concurrently filed RCE Transmittal, entry of the present amendments and of the presently submitted Declaration, and reconsideration and allowance of all claims remaining in the application, are respectfully requested.

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Respectfully submitted,

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